



White Paper  
Towards a European Water Data Ecosystem  
Building the foundation for Digital  
Transformation and a Digital Economy in the  
Water Sector

DRAFT

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# LIST OF ACRONYMS

ACRONYM	FULL TITLE
FAIR	Findable, Accessible, Interoperable, Reusable
INSPIRE	Infrastructure for Spatial Information in the European Community (Directive 2007/2/EC)
ISO	International Standards Organization
OGC	Open Geospatial Consortium
OMS	<a href="#">Observations, Measurements and Samples (OGC/ISO 19156:2023)</a>

# SUMMARY

*With the endorsement of the EU Water Resilience Strategy, including an action to “Develop an EU-wide Action Plan on Digitalization in the Water Sector”, due in 2026, momentum has been created for significant new steps to address Europe’s vast water challenges, placing digitalization at the core of the toolbox to deliver a solid response.*

*Digitalization is intrinsically connected to data. Data which are FAIR – findable, accessible, interoperable and reusable. Data which are shared seamlessly. A Water Data Ecosystem. Achieving that requires leadership attention to data management as a strategic asset – thus this White Paper!*

In a nutshell, moving the European Water Sector forward is strongly tied to shaping a Water Data Ecosystem allowing for seamless Data Sharing.

The context for European Water Data is changing rapidly. Digitalization of the Water Sector is perceived as a key lever for addressing the challenges facing the European Water Sector. But Water Data are scattered, difficult to find and access, and in many cases not interoperable leading to significant transactional costs.

A solid framework for a European Water Data Ecosystem is needed. This is strongly reflected in the recently launched EU Water Resilience Strategy<sup>1</sup> and also in the Mission Letter to Commissioner-Designate for Environment, Water Resilience and a Competitive Circular Economy<sup>2</sup>.

Importantly, the Mission Letter adds utility data to the picture. This allows for data from the entire water cycle to be included in important Decision Support Systems e.g. Integrated Urban Water Pollution Management, Cloudburst Management, Source to Sea Analysis and Planning, Cross-border Ecosystem Management, Environmental Impact Assessment, Flood Risk Management and Flood Warning Systems.

The Water Sector is categorized by having a rather decentralized structure and a strong focus on specific sub-domains. Most water data management systems of utilities, cities, industries and river commissions function independently, e.g., compared to the interconnected electricity and road infrastructure systems.

This sub-domain focus pays limited attention to interactions across the water cycle. Hence data related to ground water, surface water, wastewater and the marine are often structured without a systemic focus on data sharing between these sub-domains, thus preventing interoperability.

The potential for value creation is easily measured in hundreds of millions of Euros: reducing costs and time of public sector work processes; improving Technical, operational and Production Processes as well as construction works; substantially increasing solutions and knowledge of researchers and innovators due to access to relevant data; and, at the core of matters, improving Environment, Climate, Quality of Life.

Data is the foundation for making good decisions and in respect to water it is often data over time which allows decision makers to make the right decisions. However, data is often not treated as a business asset nor as a national asset. Hence it is often left to technical people building and collecting data and deciding on which data are important. Often, they only take a sub-domain perspective and don’t see it from the perspective of the featured problem – the river catchment, the whole urban area, sometimes not even the whole utility.

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<sup>1</sup> [https://commission.europa.eu/topics/environment/water-resilience-strategy\\_en](https://commission.europa.eu/topics/environment/water-resilience-strategy_en)

<sup>2</sup> [https://commission.europa.eu/document/10a1fd18-2f1b-4363-828e-bb72851ffce1\\_en](https://commission.europa.eu/document/10a1fd18-2f1b-4363-828e-bb72851ffce1_en)

This implies that for the really big decisions where you have to go across various sub-domains it is hard to get access to the right data. Willingness to share data constitutes a challenge but combining data across organizations often poses a critical and very costly challenge.

This is not just a problem at the organizational level but also at the national and international level, where different government departments and international organizations set different standards for basically the same data. E.g. most governments and international organizations do not have unique identifiers on chemical compounds, sometimes they even just publish the name without reference to a classification.

Interoperability has so far mostly been handled as an add-on to the data produced. Hence the focus has been to develop standards for interoperability on top of data collected, but only limited attention given to ensure that data is produced in an interoperable manner. The result is, e.g., that data on Chemical compounds produced by different actors are subject to interpretation before they can be shared. An interpretation which can be difficult to make as the area is complex. A real-life example is a government agency with highly skilled experts reported the same chemical compound with three different names in an official document – not being aware that it was the same.

At its core, this White Paper offers a vision that *public authorities and private actors should share, use and reuse observable and measurable data in a standardized, harmonized and uniform way.*

While getting agreement to the above statement might be simple, translating it into real action will be difficult. This is due to several factors. Though organizations may agree to the vision of data sharing in principle, data sharing comes with a cost. Hence, organizations tend to shy away from taking on these extra costs. By making the data interoperable at the production of data these costs will be reduced as the need to interpretation is reduced.

Water4All calls for a European Water Data Ecosystem to focus on lowering the cost of sharing data by ensuring that data produced as uniformly as possible. This should technically be based on on the ISO standard for “Observations and Measurements and Samples”.

Further, Water4All calls for making the registration of data across various sub-domains more aligned and less complex. A domain driven approach where different sub-domains such as groundwater, surface water and marine water could use very similar or perhaps even similar data models for physical, chemical and biological parameters should be explored. If data models across sub-domains could be made more uniform this would increase interoperability and make the IT infrastructure less complex and hence cheaper.

At the dawn of digitization, collection of data was mainly driven by the research community. This role was gradually taken over by utilities and in particular public monitoring, not least with the endorsement of legislation like the Water Framework Directive, the Drinking Water Directive and the Wastewater Directive.

In recent years, we have seen a new change in the primary users of water data. Private sector companies have emerged providing sophisticated digital services to improve water data management. However, the lack of interoperable data and uniform data standards act as an obstacle to the scalability of these solutions.

The public sector is increasingly using water data as an integrated part of major economic decisions. An example of this is the use of water data in environmental impact assessments. Here, the lack of uniform water data slows down permitting processes, delaying new plans and projects related to Green Transition.

Recalling the decentralized character of the water sector with data management systems being developed in many ways, vested interests are deeply rooted and will not make it an easy task to form a European Water Data Ecosystem. The White Paper therefore puts forward several detailed recommendations, divided into Organizational and Political, Technical, Cultural and Resource sections, all with huge importance.

Strategically, it will be crucial to bring regulatory steps to the forefront and to have public authorities leading the way. Technically, giving importance to implementation of standards will be necessary. In a cost-efficiency context, ensuring interoperability should especially happen by making data harmonized at the data production levels.

An example is achieving interoperability regarding chemical parameters by digitalizing relevant EU directives and providing access to a shared code list with unique identifiers and semantics for the chemical parameters.

Building a Digital Economy in the water sector should be compared to creating the EU Inner Market and converting it to a single currency to foster economic growth and remove hindrance to trade. A single currency in the context of water data should be understood as data being FAIR – Findable, Accessible, Interoperable and Reusable.

Quite a task is ahead of us. This task is too important to be passed on to data scientists and IT architects. Top management needs to engage, to understand the basics and be able to steer the development, as they do for managing economics.

# ABOUT THIS WHITE PAPER

*This white paper contributes to building of a European Water Data Ecosystem. It outlines the potential value while also describing the barriers we are facing. Finally, it provides recommendations to overcome them. A roadmap for such a process is provided.*

The paper is deliberately intended to be non-technical, as the objective is to create leadership attention, eventually at a scale of the attention leadership pays to economic management. Accordingly, it does not come with in-depth descriptions on technical how-to, rather it emphasizes the “why”.

In brief the content of this paper is:

- WHY? – Looking into the value potentials, barriers and problems
- WHAT? - Brief introduction to the concepts of FAIR data, data management, data sharing and data spaces, building a common terminology – and description of the core elements to constitute a European Water Data Ecosystem
- HOW? – Outlining a Road map and recommendations for building a European Water Data Ecosystem, with particular emphasis on enabling of FAIR data sharing
- ANNEXES – Detailing the technical concepts; overview of other relevant European initiatives on Data Sharing and National Water Data Portals; proposal on harmonization of data for chemical substances

The White Paper is a deliverable of the Water4All Partnership<sup>3</sup> and has been produced by a Working Group under the Water4All Data Sharing Task, led by the Danish Environmental Portal, and has been endorsed by Water4All governance bodies – Pillar C Plenum, Executive Board, Governance Board and Advisory Board.

The White Paper aims at contributing to the European Resilience and Competitiveness Agendas. In other words: building a Digital Economy in the Water Sector Market, with products and services based on data.

These agendas are stipulated in the EU Water Resilience Strategy and the adjoined Digital Action Plan. The aim of these agendas is to modernise and standardise water management through advanced digital technologies. It operates at the intersection of the green and digital transitions, directly supporting the competitiveness objectives by helping secure resource availability across multiple sectors.

The Digital Action Plan aims to leverage enormous data flows and increased interoperability to drive innovation and efficiency. Enabling data sharing and encouraging forming of National Water Data Portals are key operational elements.

To get the complexity right, it is important to distinguish between the data foundation, the digital infrastructure and the use cases, which use data - altogether a digital transformation of the water sector.

While digitalization scoped as new technologies has taken center stage, the need for making data FAIR – Findable, Accessible, Interoperable and Reusable – in order to enable data sharing and development of a joint data foundation, is not gaining traction. The mission of the White Paper is particularly to contribute to this specific part of digitalization – focusing on the raw material: data.

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<sup>3</sup> <https://www.water4all-partnership.eu/>

# WHY? – WHAT WILL BE THE BENEFITS OF A WATER DATA ECOSYSTEM?

*Digitalization is perceived as a key lever for addressing the challenges facing the European Water Sector, maybe even the lever. A Water Data Ecosystem, which enables data sharing, is essential as it provides the raw material for digital tools. With a widely accepted understanding of the value potential of digitalization, data should be given strategic attention at leadership level. However, this is not the case in all organizations or in the water sector as such.*

*Discussions about Digitalization focus on new solutions for data use. Investments in new facilities, infrastructure and IT software are all data-driven, but not realizing that with subsequent investments in data, investments would not only have a higher return, but also come with better decision support, better exchanges of data e.g. between utilities and authorities and much more innovation.*

*This chapter offers an overview of the value potential of a European Water Data Ecosystem as well as its current stage and barriers to getting there: why haven't we made it there yet?*

Today, the Water Sector is organised by a decentralized structure and a strong focus on specific sub-domains. Most technical infrastructure of utilities, cities, industries and river commissions functioning independently e.g. compared to the heavily interconnected electricity and road infrastructure systems. Altogether, data production and data management typically have a local perspective.

Consequently, data sharing takes place at a rather low level and only limited attention has been given to development of a joint, European water data ecosystem. Data sharing is hampered by significant interoperability issues, and finding and accessing data is in most cases difficult.

Hence data related to ground water, surface water, wastewater and the marine are structured without a systemic focus on data sharing between the sub-domains.

Attention should also be given to inefficient reporting systems where data requirements are not aligned, e.g. between Member States and EU Institutions including the EEA, European Environment Agency.

The result of this is that decisions on rules, regulations and investments in water are often based on inadequate silo-based information instead of taking a holistic approach to water management.

The Water Framework Directive was a landmark piece of legislation as it called for a catchment-based approach to water management, covering the entire water cycle. At the time of the launch of the WFD, IT capacity was not at a stage, where tools could handle datasets resembling entire catchments. Now data ecosystems should be designed to mirror the physical ecosystems.

In most Member States, it is, however, quite difficult to find and access relevant data at catchment level. Data sharing between different levels of Government (State, region, municipalities) is not always facilitated.

For data-driven innovation and research as well as transboundary data sharing, this comes with huge difficulties.

An overall, holistic policy framework for Water Data Management is therefore now highly needed. At the centre of the Policy Framework, the needs of the most important use cases should be placed.

## USE CASES - DATA FOUNDATION

Water Management include a broad range of tasks – use cases. For these to incorporate advanced digital tools, a data foundation consisting of data from different sources and of different types is needed.

In the context of elaboration of a Policy Framework, it is imperative to understand that these different use cases rely on combinations of the same data. E.g. data on hydrometry – how the water flows and where it is – common to most use cases. A recent study on Value Estimate of a common hydrometry system documents these conclusions<sup>4</sup>. In the following examples of water management use cases are listed:

Use Cases	Data Sharing and Interoperability dependency
Integrated Urban Water Pollution Management	Several Monitoring Entities from different government levels; Physical parameters (hydrometry) as foundation for digital twins and models, combined with chemical parameters. With the implementation of the Urban Wastewater Directive, the perspectives related to a joint data foundation will be multiplied.
Groundwater Management	Several entities are involved in Groundwater Management, albeit with different tasks but significant data dependencies. Work processes related to groundwater resources management and long-term planning, quality monitoring, mapping and modelling of magazines, permitting of extraction including impact analysis related to surface water flows and biodiversity, planning and construction of new drilling investments etc.
Source to Sea Analysis and Planning	Cross Border, both from source to sea, but also marine data across borders; Connecting Surface Water Quality and Marine Water Quality
Cross-border Ecosystem Management	Ecosystems are often functioning across administrative and national boundaries. Requiring FAIR and interoperable data on chemical parameters, biological parameters. For marine ecosystems, physical parameters in addition to chemical and biological parameters are also crucial and for seabed habitats chemical, biological, physical, bathymetric and geological parameters are the minimum. High resolution of temporal and spatial data is also crucial, considering some ecosystems (freshwater lakes, rivers, coastal zones and marine) are 3-dimensional.
Environmental Impact Assessment	A multitude of entities, geographical information, data harvesting time consuming
Cloudburst Management, Flood Risk Management and Flood Warning Systems	River Flood Risk and River Flood Warning involve upstream and downstream entities, geographical information; River flows and levels, groundwater levels close to surface, technical infrastructure sewers and overflows, sea water level, waves and tides that define submersion risks. Sea Level Rise is indeed important and requires multi-parametric data (bathymetric, physical, among others).
Monitoring-as-a-Service	A harmonized and pan-European approach to monitoring methods and procedures for analysis, unambiguous reporting formats, and data management is a prerequisite for M-a-a-S
Combined Sewer Overflows (CSOs), where water flows from technical infrastructure via Overflow Works to recipients.	Overflow data are being elevated from local estimates to real-time monitoring in line with other hydrological measurements. This fits in with a growing interest in real-time data, which enables better warning, management and optimization of operation and maintenance. Furthermore, there is a growing interest in using observation-based databases to qualify the sector's investments and asset management.
Asset Management	Utilities have significant economic value tied to the pipe infrastructure installed. Expanding lifetime extension poses huge economic value potential. Often lack of adequate data prevents undertaking analysis and decisions.

<sup>4</sup> Water4All / Danish Environmental Portal study at Water4All website - <sup>4</sup> <https://www.water4all-partnership.eu/joint-activities/data-sharing>

The transformation is not only about new technical solutions, but about changing the underlying business processes, data chains and forms of interaction between actors. In a digitally mature administration, data is not just a reporting requirement, but an active management tool that can be used across administrative levels and sectors – from operational optimization and investment prioritization in utilities to planning, regulation and citizen communication in municipalities and at the state level.

## ECONOMIC SAVINGS, SHORTENING OF TIME SPENT ON WORK PROCESSES AND FASTER PERMITTING

An inadequate data foundation is not only hampering water management tasks and preventing effect regarding water security, improving the environment and quality of life. It also has substantial impacts on inefficiency in work processes. Time is spent on unproductive activities, causing unnecessary costs, delays, and, in the end, time-consuming application processes e.g. permitting.

The current European political focus on faster application processes for permits through simplification of the application procedures could benefit from looking shortening of the duration by providing a joint data foundation.

A tool for providing a faster overview of existing data of relevance for Environmental Impact Assessment processes has been developed. Also, a tool for fast access to semi-structured data (reports), normally in the format of pdf's and very difficult to find and access relevant data to a specific EIA topic has been developed. Value estimates for the use of these two tools point to an economic value potential in the range of billions of euros.<sup>5</sup>

The process of an application submitted from, say, a utility to a municipality often involves several iterations where data are exchanged between the parties, sometimes involving a consultant or a researcher. Without a joint data foundation ensuring interoperability, and a joint system allowing for direct access to the shared databases or agreed data catalogues, each iteration comes from data being transferred from one system to another and time spent on formatting to the next system.

In-between results from consultancies or researchers may be presented in pdf's, again leading to incorporation of data into a new system. With each iteration, on top of data interpretation with all the uncertainty connected to this, unproductive time is spent leading to nothing but unnecessary costs.

Sadly, these are often hidden costs, not brought to the attention of top management. Thus, the business case related to a joint data foundation comes with huge, economic potential – and, accordingly, a possibility for water managers to get funding from the top management, if presented this way.

## BRIDGING DATA FROM TECHNICAL INFRASTRUCTURE AND DATA REPRESENTING THE PHYSICAL ENVIRONMENT – DATA SECURITY

The Water Sector consists of two major elements, the physical environment and the technical infrastructure. While closely intertwined when focus is on the natural water cycle and the environment, it is in its physical

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<sup>5</sup> Danish Environmental Portal study at Water4All website - <https://www.water4all-partnership.eu/joint-activities/data-sharing>

shape decentral by design when focus in on the technical infrastructure. This has led to several different independent data management systems have been developed, without reflection on interoperability.

However, as the state of the environment is the common denominator for a vast number of uses cases, eventually this must imply that the data model used for managing these data must constitute the core of an overall approach for data management in the water sector.

Water Management, understood as the work processes of public authorities responsible for delivering good, ecological status (as termed in the Water Framework Directive), investigates monitoring, analysis and planning for the whole water cycle (groundwater, freshwater, wastewater, coastal water) based on river catchments. Data on the state of water bodies are constantly part of the equation.

Technical Infrastructure, operated by utilities, are local by physical shape. Water Resources, being groundwater or surface water, connects to Water Works, transmission and distribution systems to water use in industries or households, and from here via sewer systems to Wastewater Treatment plants discharging to natural water bodies. Operating the technical infrastructure with several processing steps and technological components e.g. pumps and valves are increasingly digitized, digitalized and even taken into digital transformation in some cases. In most cases, data is produced and used for operating the technical infrastructure, taking place behind SCADA walls for security reasons. Nobody must be able to get access to this critical infrastructure.

#### [Urban Water Data Management Systems and River Data Management Systems.](#)

Harmonizing data must start by national authorities harmonizing their approach to data production (monitoring activities) across all levels of government. This eventually also related to Urban Water Data Management Systems and River Management Water Data Management Systems.

It doesn't make sense that independent Urban Water Data Management Systems each have with their own, not harmonized format (data model), as they are only serving a limited number of users. Eventually, any data from an urban system should be made available at the national level to maximize data describing the water catchments / physical ecosystems.

Urban Water Managers, River Water Managers and National Government Water Managers do not need exactly the same data. They will each have their specific use case, but seen from a physical environment point of view, the use cases often need data from larger catchment areas than the administrative boundaries of the organization itself. A huge number of such data dependencies from external, physical environments and catchment exist. Without a common approach, data sharing will continue to pose huge challenges.

## IMPORTANCE OF A NATIONAL WATER DATA PORTAL

Altogether, these cases call for various types of data sharing. The recommendation of the EU Water Resilience Strategy to establish National Water Data Portals is key to starting a water data ecosystem.

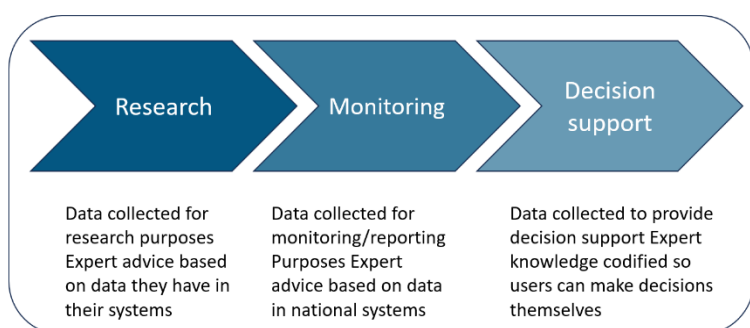
It is a crucial recommendation to build this organization with broad ownership, not just as a unit within a single government agency. Although the latter may be the easiest decision, it comes with huge risks of not being able to deliver the long-term goals of fostering Digital Transformation of Water Management and contributing to a Digital Economy in the Water Sector. If organized as a unit within a Government Agency, it will be biased towards interests of this agency only. Instead, it is recommended that a National Water Data Portal is organized as a co-owned structure between all levels of Government – state, regional and local.

It is essential that decisions about ownership and organization don't follow what is optimal on a short-term horizon e.g. that an EPA right away sets up a structure organized around its own data and needs, just

because it is the easiest solution. Rather, these decisions should consider the value perspectives of society as such, since predicting what data can be used for is close to impossible.

A National Water Data Portal should see itself as an enabler of Digital Transformation in all aspects of Green Transition. In parallel, EU institutions in charge of reporting from Member States should aim at aligning the data format embedded in their reporting requests based on a self-understanding of being first-movers towards implementing a European Water Data Ecosystem.

During recent decades, there has been an overall shift in the main reason driving data collection. Researchers were first movers, seeing the benefit for their work in compiling large data sets. Then followed the increasing focus of monitoring the state of the environment not least with the launch of the Water Framework Directive. Recently, however, decision support systems have been taking center stage in order to have a data-driven foundation for achieving political and business goals of authorities, utilities and private sector.



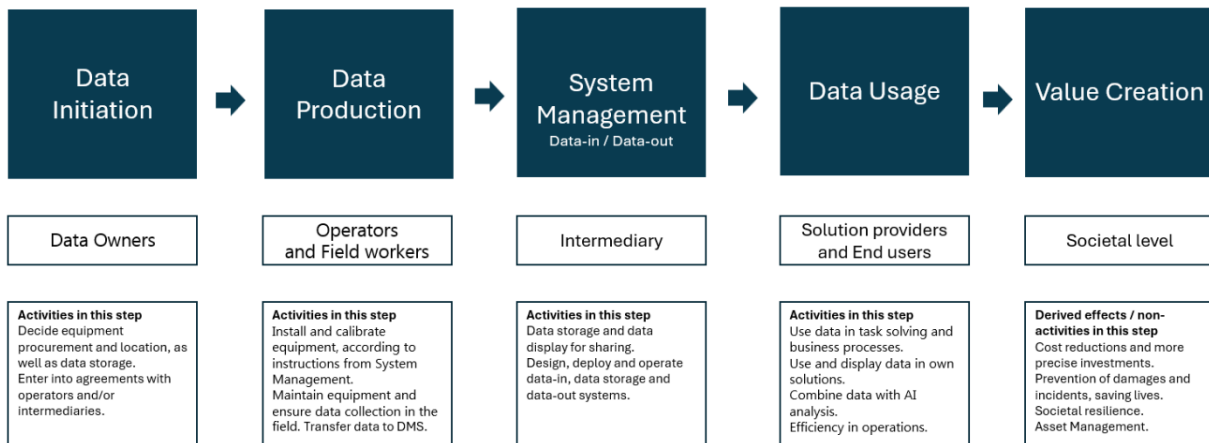
A key component of the value chain are the data services that assemble, standardise and harmonise data from multiple (often hundreds) of different sources into FAIR data layers that can then be used for decision-making and other applications.

For Decision support, data from different organizations and different sectors often need to be compiled, often across administrative and even national boundaries, and covering the entire water catchment. For efficient work-processes, which are not hampered by time wasted on data washing, a joint water data ecosystem is increasingly needed.

Well-functioning infrastructure for data sharing therefore needs attention, with National Water Data Portals as a key element for unleashing the potential for value creation.

## NATIONAL WATER DATA PORTALS – THE CRUCIAL ROLE OF AN INTERMEDIARY

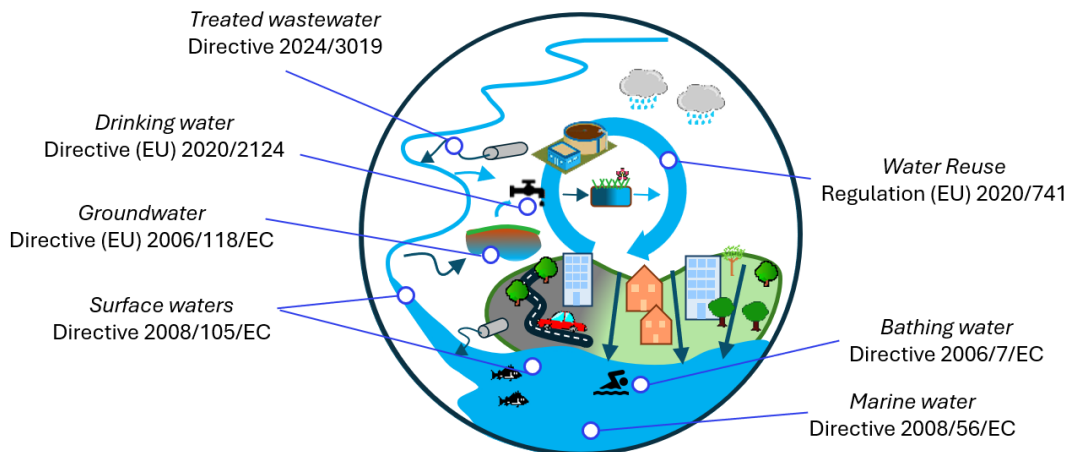
Essentially, National Water Data Portals are intermediary organisations organizing data from many sources to be available for many use cases.



In this role, the Intermediary also has a unique overview and a special opportunity, some may say obligation, to make sure that ends meet. To communicate that all use cases make use of the same data. That the same conceptual data model encapsulated in the Observation and Measurement Principles should constitute the foundation for all users, and that the same logical data model should be applied for the entire water cycle.

Further, the Intermediary should be instrumental in identifying the user needs and base the IT infrastructure to support the transfer of data from the data production sources to the users.

In some cases, specifically water management and realizing the political goals on water security and resilience, regulatory requirements will constitute the main driver for the use cases as illustrated in the figure below<sup>6</sup>. In other cases, economic goals will be the main driver. A major communication task of an intermediary is to communicate that the effect of data-driven water management tasks and the economic gains of efficient, data-driven work processes bases on the same data. With this understanding, water managers and top leaders of organizations have a shared interest in building a joint data foundation.



## POTENTIAL FOR VALUE CREATION OF A JOINT DATA FOUNDATION

The potential for value creation includes a.o.:

### Public sector work processes and decision support tools

<sup>6</sup> Illustration developed by the UrbanM2O project - <https://urbanm2o.eu/>

- **Reducing costs and time** spent by Environmental Authorities for a range of tasks including permits and enforcement processes, management and analysis related to water pollution problems as well as EIAs (Environmental Impact Assessments) and cross-sector analysis and priorities.
- **Smoother transfer of data** within national levels, as well as at international scale especially when water flows across countries, including reporting to EEA and other EU structures.
- Improving **flood warning systems** and other emergency systems.
- Allowing for **better integration** of water flows and levels of rivers, cloudbursts, floods, droughts and groundwater close to the surface, altogether improving climate change adaptation.

#### Technical, operational and production processes of utilities and water consuming companies

- **Reducing operational costs** for operating data management systems and ensuring harmonization of data from different sources, leading to increased interoperability and reusability.
- Overall, implementation of **better communication** lines between organizational leadership and IT developers, allowing for new IT solutions to have a stronger emphasis on value creation.
- Construction works more precisely, **reducing both costs and resources** used.
- Improving **asset management** and strengthening foundation for long-term economic value.

#### Research and Innovation

- Improving researchers and innovative companies **finding and accessing data**, not least results of monitoring programs, leading to strengthened relevance of new solutions and knowledge.
- Development of **better digital decision support** tools based on harmonized data, including increased frequency of planning cycle, e.g. nutrient management and reduction of eutrophication.
- Essentially, **upscaling of a Digital Economy in the Water Sector**.

#### Environment, Climate, Quality of Life

- Improved environmental quality – ecosystems, water recipients, biodiversity protection.
- Improved health conditions due to improved drinking water quality and pollution reduction.
- Decreasing carbon and other greenhouse gas emissions.
- Speeding up implementation processes for renewable energy.
- Essentially, shared use of structured data will substantially improve conditions for **innovation of data-driven solutions and technologies** in the Water Sector.

User needs must be placed at the core of matters. This is where value is created. This is what finances the value chain. But data users themselves do not always understand how to build the necessary digital infrastructure. Data users do not always understand the needs of other data users. Comprehensive analysis of data needs across several users are important to build efficient and effective systems.

Upscaling innovation of data-driven solutions and technologies requires a solid data foundation as a prerequisite for generating investments: uncertainties about the “supply side”, availability of relevant data, as well as uncertainties about market potential, use of new solutions, both slows interests of investors.

Innovators need access to data from different players e.g. utilities to secure that new solutions are widely applicable and not customized to one player only. Ideally, relevant data should be available from players in several countries to provide a Pan-European market perspective.

To launch an adequate pan-European process towards a joint Water Data Ecosystem and to develop actionable recommendations for the Digital Action Plan requires a solid understanding of the current situation. This is presented in the following chapter.

# WHY ARE WE NOT THERE YET?

Data is the foundation for good decisions in water management, but both time and quality matter. Decision-makers need access to the newest data without waiting years for full quality assurance. Flood warnings depend on current hydrometry data, and water quality policies cannot rely on outdated information.

Despite this, data is often not treated as a strategic business or national asset. Decisions about what data to collect and prioritize are frequently left to technical specialists working within narrow sub-domains, rather than being viewed in the broader context of a river catchment, an urban area, or an entire utility. As a result, it is difficult to access and combine the right data across sectors, organizations, and systems.

Poor data sharing and weak interoperability create major risks. Organizations often struggle to combine data from technical infrastructure and the environment, and in some cases even internal systems cannot communicate. This increases the chance that major decisions are based on incomplete or unsuitable data.

This White Paper is therefore written in non-technical language to help a broad group of stakeholders - especially organizational leaders - understand why data management must be treated as a strategic issue alongside finance, HR, and innovation. If digitalization is to deliver value, greater attention must be given to its raw material: data.

Across the water sector, data is increasingly collected for purposes beyond its original use, but it is often stored in inconsistent formats, structures, and documentation. That makes it hard to combine data across disciplines or even between providers in the same field. Governments may spend months harmonizing data for water management plans, reporting, and evaluations - time and money that could be better spent solving actual problems.

Interoperable and reusable data - report once, use many times - creates significant value, but lack of common practices makes this costly to achieve. In fact, much of the effort goes into cleaning and harmonizing data rather than analyzing it. The challenge also extends beyond individual organizations: national and international bodies often use different standards for the same data, making comparison difficult. In areas such as chemical compounds, the absence of unique identifiers can lead to confusion and inconsistent reporting.

Because water crosses sub-sectors, organizations, and borders, weak data exchange makes effective water management slower and more difficult. Initiatives such as the INSPIRE Directive have helped create frameworks for harmonized geospatial and environmental data, including water-related datasets, but compromises have limited their full impact.

Water4All therefore presents a vision for a Water Data Ecosystem, together with key technical principles and recommendations for launching a joint, multi-stakeholder process. Many related initiatives already exist, and these should be brought into a common dialogue. Overcoming the sector's long-standing technical silos and lack of standardization is essential if water data is to support faster, better, and more coordinated decisions.

## OVERVIEW OF BARRIERS

- **Organizational and political barriers**
  - **Top management does not pay attention to their organization's data assets.** Data models are like IT architecture – Top management leave it to the experts
  - **The value of data is not monetarized**
  - **To share data is not an "emergency" political agenda item**

- **It is the organization using data which gets the benefits not the organization sharing data.** There are virtually no incentives or regulatory structures in place to enhance data sharing, except reporting requirements – which in turn rarely are aligned but rather requesting different formats.
- **Lack of willingness to share data.** Many organizations and departments in organizations are hesitant to share data as they perceive that other organizations should just look at their website, not realizing that the value of the use of data is far bigger when data is combined. Some are afraid others may do business with ‘their’ data – the “my precious syndrome”
- **Political and Institutional Factors:** Political differences and institutional barriers, such as bureaucratic processes, competing priorities, and jurisdictional disputes, can hamper efforts to establish common data sharing frameworks and protocols. Lack of political will and leadership may also hinder progress in this area.
- **Cultural barriers**
  - **Cultural and Linguistic Differences:** Cultural and linguistic diversity within the EU can pose challenges to effective communication and collaboration among stakeholders. Language barriers may hinder the sharing of data, information, and knowledge, particularly among regions with different linguistic backgrounds.
  - **What’s in it for me?** Data sharing and providing data in a harmonized format will require resources and economy. Resources that are used for others outside “my project” to understand “my data”. Political pressure, commitment and investment are crucial to make it happen.
  - **Lack of Trust and Transparency:** Concerns about data accuracy, reliability, and misuse may undermine trust among stakeholders and discourage data sharing. Building trust through transparent processes, data validation mechanisms, and accountability measures is crucial for promoting collaboration and cooperation in data sharing initiatives.
- **Resource barriers**
  - **Resource Constraints:** Some Member States may lack the financial, technical, or human resources needed to develop and maintain robust data sharing mechanisms. Limited investment in data infrastructure, capacity building, and training can impede efforts to improve data sharing across borders.
  - **Knowledge constraint:** many domain (water quality, hydrogeology, etc...) do have some data handling training in their curriculum (Database or GIS courses) but not enough effort is put into registration patterns, cross sector data handling etc. (e.g. the INPIRE directives). This makes it harder for organizations to hire and put the right profile in front of their data challenges; leading to an even more fragmented landscape described above.
- **Legal barriers**
  - **Legal and Regulatory Frameworks:** Legal and regulatory barriers, such as data protection laws, privacy regulations, and intellectual property rights, can restrict the sharing of sensitive or proprietary data across borders.
- **Technical barriers**
  - **Data models in the production systems are too complex** and not aligned across sub-domains
  - **Fragmented Data Systems:** EU Member States often maintain separate data systems for water monitoring, management, and reporting. Lack of integration and interoperability between these systems makes it challenging to share data seamlessly across borders.

- **Diverse Data Standards:** Different member states may use varying data standards (local, national, EU, international), formats, and protocols for collecting, storing, and sharing water-related data. Incompatibility between these standards complicates efforts to harmonize data and facilitate cross-border sharing.
- **Technical Challenges:** Technical issues, such as outdated infrastructure, limited bandwidth, and incompatible software systems, can hinder the exchange of large volumes of data across borders. Ensuring compatibility and interoperability of data systems is essential for overcoming these challenges.
- **Data is a domain of expertise by itself,** but data is often delegated to IT teams. But IT developers, architects, UX/UI experts are not often Data experts and thus not inform about practices to be applied and the current legislation (especially in the environmental domain)
- **Limited access:** No access for researchers, innovators and service providers to the large data volumes of end-users (utilities, river commissions, national monitoring programs). Data Owners and Data End-users don't see themselves as part of a Data Ecosystem

# WHAT? – OUTLINING A VISION FOR A EUROPEAN WATER DATA ECOSYSTEM

*The previous chapters introduced value potential as well as barriers for data sharing. Structured data as foundation for a digital transformation of the water sector was described as a key necessity for smooth and effective data sharing. Therefore, the task now is to outline WHAT it will take to realize the potential while recognizing the barriers. This chapter calls for establishing a European Water Data Ecosystem, introduces its key elements and places National Water Data Portals as the main, operational element.*

Definitions<sup>7</sup> of a data ecosystem vary, but for the purpose of data sharing this White Paper uses a broad one:

*A data ecosystem is an interconnected network of people, organizations, technologies, and data sources that work together to collect, manage, analyze, and share information. Like a biological ecosystem, it depends on the interaction and health of all its components to create continuous, data-driven value.*

The water domain fits this analogy well. It is densely cross-cutting, with strong data interdependencies between the physical environment (the natural water cycle, water bodies, ecosystems) and the technical infrastructure (water works, distribution, sewers, wastewater treatment) operated by utilities. Current capacities, competences and digital maturity vary widely between Member States and even within organizations, and the barriers to progressing people, institutions, budgets, vested interests, regulation, uneven distribution of costs and benefits — are equally varied. Addressing them calls for a "moon shot": a clear, ambitious vision capable of guiding a complex transformation with more unknowns than knowns.

## VISION

The Water4All Vision for a European Water Data Ecosystem is formulated as follows:

Public authorities and private actors should  
**SHARE, USE and REUSE**  
observable and measurable data in a  
standardized, harmonized and uniform way

The bullets below constitute a general goal for data sharing, no matter if it is water-based data or not. All sectors working with data sharing should work with these principles.

- Data collected for a local perspective should be re-usable for many other purposes, thus creating the foundation for building a Digital Economy in the Water Sector
- Data collected in proprietary formats should be shared in an open and well-determined format
- Data understood in a local context should be transferred to widely understandable data
- Overall, move away from sub-sector approaches to domain solutions, e.g. don't make solutions for river flows, but make them for continuous measurements.

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<sup>7</sup> A number of definitions are provided in Annex 5

Crucially, building such an ecosystem is not primarily a technical exercise. It depends on people and organizations agreeing to share, on governance arrangements that span administrative levels, and on overcoming a fragmented sector where data has historically been produced in decentralized, uncoordinated ways — behind SCADA walls in utilities, in sub-sector silos in public authorities, and in proprietary formats that resist reuse.

## OBJECTIVES OF A EUROPEAN WATER DATA ECOSYSTEM

### **Desired future situation**

A situation where public authorities, universities, the private sector and citizens cooperate to share interoperable data, which are used in future decisions by the same actors.

The data is interoperable across various environmental sub-domains and is by default made available to all immediately after registration, but with a clear description that this data has not yet been quality approved and with a possibility to keep the data confidential.

The raw data is collected based on a uniformly agreed conceptual data model, which is supplemented by publicly available code lists of observable properties, e.g., code list of chemical parameters.

Knowledge products or refined data is derived from the raw data with a clear data lineage and is shared among the stakeholders.

The data is either stored in centralized for data which must be available immediately to many stakeholders or local databases for data which only occasionally needs to be shared.

Five objectives follow from this desired future situation:

#### 1. Treat water data as strategic infrastructure

Water data should be recognised as strategic digital infrastructure for Europe's water resilience, climate adaptation, environmental protection, and competitiveness.

This requires a change in leadership attention.

Data management cannot remain a back-office technical issue. It must be governed with the same seriousness as finance, physical infrastructure, cybersecurity, and regulatory compliance.

The White Paper puts forward several recommendations. Strategically, it will be crucial to bring regulatory steps to the forefront and to have public authorities leading the way. Technically, placing even more importance on the implementation of standards will be necessary.

It further requires articulating a clear "what's in it for me" rationale for data providers — backed by political commitment, investment, and resources — so that the effort of sharing data in a harmonized format is recognized and rewarded beyond the boundaries of any individual project. Finally, trust and transparency must be strengthened through robust data validation mechanisms, open processes, and accountability measures that address concerns about accuracy, reliability, and misuse, thereby encouraging sustained cooperation in data sharing initiatives.

## **2. Focus on enabling better decisions**

The purpose of managing data is, at the end of the day, to enable better, informed decisions. Often, this is narrowed down to the term “digitalisation” understood as smarter, digital tools, but the precondition is always access to all relevant data in interoperable and reusable data. This requires more than digital tools. It requires a shared data infrastructure.

Without it, Europe risks building many local digital solutions on top of fragmented foundations. That will create short-term innovation, but not systemic transformation. Building the shared data infrastructure requires a focus on what the users of data needs. Not all data are equally important.

## **3. Promote fast FAIR data access including interoperability at source**

Harmonize data at the source of production. Data collected for a local purpose should be reusable for many others. That requires moving away from sub-sector approaches (e.g. river flows) toward domain solutions (e.g. continuous measurements), adopting FAIR water data standards, and using commonly agreed classification and code lists — ideally made mandatory through EU regulation. Harmonization must begin where data is produced: with public authorities aligning their monitoring activities across all levels of government, and utilities subsequently adopting the same formats.

The core data model shall be based on the Observation, Measurement and Samples principles and all exchange of data shall meet the specifications derived from the common model. E.g. data from a sensor on a detailed level would be defined according to Observations, measurements and samples.

## **4. Establish National Water Data Portals as trusted intermediaries**

A National Water Data Portal (NWDP) is a registry and repository for all publicly monitored water quantity and quality data, made available in a FAIRified format, free of charge, to an unlimited number of users. Because the state of the environment is the common denominator across nearly every water use case — from groundwater management and integrated urban pollution control to source-to-sea analysis and flood warning — the NWDP's data model should be the reference that other systems align to.

To deliver on this role, an NWDP should:

- Be co-owned across state, regional and local government, rather than housed inside a single agency whose interests would otherwise bias the solution;
- Make environmental data findable and accessible as reference data for entire river catchments;
- Facilitate bridging between data on the state of the environment and data from technical infrastructure operated by utilities, so that pressure data (e.g. wastewater discharges, combined sewer overflows) can be related to recipient data in a coherent format.

Organizing the NWDP narrowly around one agency's short-term needs is the easiest decision, but it forecloses the long-term value of ensuring that a broader range of needs are accommodated.

## 5. Develop and provide access to open-source software components

Today, different reporting formats, regulatory requirements, funding programmes, and data initiatives may point in different directions. This creates fragmentation even when the stated ambition is harmonisation.

If Europe wants a Water Data Ecosystem, the policy system must reward shared infrastructure, reuse, and interoperability.

The present IT infrastructure landscape in Europe in the field of water data is scattered and fragmented. Solutions have been developed by individual organizations focussing on their own narrow needs.

This act as a barrier to data sharing as each individual solution has its own data models and data standards. This reduces the value of the data generated for others. As the data must be transformed into other formats to make the data eventual interoperable. In doing this several subjective decisions will be made which reduces the reliability of the data. It is costly as changes in one system will require changes in another system.

EU policies ensuring alignment of reporting formats based on the commonly agreed classification and code lists and that all new regulatory initiatives refer to the use of shared codelists and unique identifiers of parameters. To adopt a shared parameter list for chemicals and update existing regulations accordingly, and to adopt a shared list of observable properties e.g. chemical parameters and taxonomy. Further to undertake a strategic review of interoperability and reusability of biological parameters. To develop operational guidelines on how to build a common approach to design of data models. Promote use of a common metadata data catalogue to make findability of data more efficient. Finally, to initiate a broad communication campaign to promote the vision and recommendations.

## FIVE RECOMMENDATIONS

Together, these five elements — Water Data as a Strategic Asset; Focus on Enabling Better Decisions; Promoting fast access to data and harmonization of data at source; National Water Data Portals; Access to Open-source Software Components — form the digital infrastructure of a European Water Data Ecosystem capable of supporting digital transformation across the water sector and contributing to a wider digital economy in water.

# RECOMMENDATION 1 - TREAT WATER DATA AS STRATEGIC INFRASTRUCTURE

Water data should be recognised as strategic digital infrastructure for Europe's water resilience, climate adaptation, environmental protection, and competitiveness.

This requires a change in leadership attention.

Data management cannot remain a back-office technical issue. It must be governed with the same seriousness as finance, physical infrastructure, cybersecurity, and regulatory compliance.

Water data infrastructure requires:

- long-term operational funding
- clear ownership
- governance across institutions
- defined responsibilities for data producers and data users
- investment in shared components
- leadership-level accountability

Project funding alone will not build infrastructure. Pilots alone will not create trust. Strategies alone will not move data.

## **Actions:**

EU institutions and Member States should explicitly recognise water data infrastructure as a core element of water resilience and digital transformation.

Funding programmes should support long-term data infrastructure, not only short-term innovation projects.

Public authorities should appoint clear responsibility for water data governance at the leadership level.

# RECOMMENDATION 2 - FOCUS ON ENABLING BETTER DECISIONS

Water resilience, climate adaptation, pollution control, biodiversity protection, and industrial competitiveness are becoming more tightly connected. At the same time, digitalisation is being presented as a key lever for transforming the water sector.

But digitalisation without interoperable data is a weak promise.

AI cannot compensate for poor data foundations. Digital twins cannot scale if every dataset must be manually interpreted. Real-time monitoring has limited value if it cannot be connected to regulation, planning, and decision-making. Faster permitting depends not only on simpler procedures, but on faster access to trusted data.

The next generation of water management will depend on the ability to combine data across:

- groundwater, surface water, wastewater, coastal waters, and marine systems
- public authorities, utilities, laboratories, researchers, and private companies
- local, regional, national, and European levels
- environmental data and technical infrastructure data
- open public data and governed access to sensitive data
- access to data immediately after the data has been created.

This requires more than digital tools. It requires a shared data infrastructure.

Without it, Europe risks building many local digital solutions on top of fragmented foundations. That will create short-term innovation, but not systemic transformation.

Building the shared data infrastructure requires a focus on what the users of data needs. Not all data are equally important.

## **Actions**

Conduct studies to document the value of water data for different users and for different needs.

Conduct studies to document what changes to the existing systems are required to address these needs.

Conduct studies on present and future political agenda items highlighting the value of water data in the investment decisions by the public sector, water utilities, the private sector and others.

# RECOMMENDATION 3 - PROMOTE FAST FAIR DATA ACCESS INCLUDING INTEROPERABILITY AT SOURCE

Europe does not lack water data. Europe lacks water data that can travel.

Across Europe, data on groundwater, rivers, wastewater, pollutants, coastal waters, infrastructure, and ecosystems are collected every day by authorities, utilities, laboratories, researchers, and private companies. But too much of it remains trapped in local systems, sector-specific formats, and institutional silos.

This is now a strategic risk.

Water resilience cuts across borders, sectors, and administrative levels. Water data must be able to do the same.

Today, it often cannot.

The water data landscape in Europe must be transformed so that public authorities, universities, the private sector and citizens cooperate to share interoperable data, which are used in future decisions by the same actors.

The benefits of doing this are enormous. Some estimates suggest that the benefit to society of making sure that data collected for one purpose can be used for other purposes have a return of investment of a factor twenty. This makes this probably one of the best investments a society can make.

The more interoperable the data are the more benefits will be provided to society. A study in Denmark on harmonizing chemical parameters across groundwater, drinking water, surface water and waste water revealed that the lack of standardization came with huge costs. As each actor data producer, laboratory and national government had to spend time and effort into translating the data. They estimated that the benefit of introducing a newly developed harmonized chemical standards list was more than € 13 million.

## **Actions**

Mandate that water data are shared both by public authorities, utilities, universities and the private sector including open access by default for publicly funded data.

Focus on raw data and making these available preferably immediately after they have been created. Include a quality stamp that it is only draft data that has not been quality approved.

As a first step focus on making all data is findable and accessible

Provide infrastructure and incentives enabling that data which were not interoperable when created can be exchanged in an eventual interoperable manner.

Provide infrastructure and incentives such as common code lists, e.g., on chemical parameters to promote the long-term goal that data is as interoperable as possible when created.

Promote data standardization so that water data are interoperable across various sub-sectors. The environment is interconnected. Hence data about the environment needs to be interconnected.

# RECOMMENDATION 4 - ESTABLISH NATIONAL WATER DATA PORTALS AS TRUSTED INTERMEDIARIES

National Water Data Portals should be the backbone of Europe's water data infrastructure.

Their role should be to assemble, harmonise, and provide access to water data across the water cycle: groundwater, surface water, wastewater, coastal waters, and marine environments.

The backbone will be publicly funded or mandated data, but the ambition will be to include data from the private sector and other sources as well to create the most solid data foundations. Thus, enabling better decisions data by making data collected for one purpose available for other purposes.

The data provided should preferably be free of charge. Estimates suggest that the return on the investments in providing free access to data may be up to factor twenty. Whereas experience suggest that selling environmental data is counterproductive and counterproductive. Putting a price on data is counterproductive as it acts as a barrier and limits the use of data. It is difficult as it is only when the data is embedded into solutions it can be sold on a commercial market.

The organisational design matters.

If a National Water Data Portal is placed inside a single agency and optimised around that agency's needs, it risks becoming another silo with a public interface. If it is organised as shared infrastructure, it can focus on the needs of the data users.

National Water Data Portals should therefore be designed as trusted intermediaries.

They should:

- be co-owned across relevant levels of government or users
- have long-term operational funding
- support many users and many use cases
- act as a facilitator between data users and producers
- focus on providing access to data through API's though some limited user interfaces may also be relevant
- focus on providing access to raw data, but also include derived data including knowledge products developed by universities
- act as a facilitator to gradually harmonize data production so that data are interoperable when created
- provide guidance and support to data users and producers

## **Action:**

Member States should establish or strengthen National Water Data Portals as shared public digital infrastructure.

Conduct a study on best practices related to Water Data Portals taken the experience from other data initiatives such as data spaces into account.

Based on this study provide guidance to define principles for governance, openness, interoperability, funding, and mandate.

National regulation should require public funded data to be submitted to the portal in agreed formats as soon as the data has been created unless and with agreed frequency.

# RECOMMENDATION 5 - DEVELOP AND PROVIDE ACCESS TO OPEN-SOURCE SOFTWARE COMPONENTS

Interoperability will not emerge at the scale and speed required through voluntary coordination.

EU policy must create the pull.

Today, different reporting formats, regulatory requirements, funding programmes, and data initiatives may point in different directions. This creates fragmentation even when the stated ambition is harmonisation.

If Europe wants a Water Data Ecosystem, the policy system must reward shared infrastructure, reuse, and interoperability.

The present IT infrastructure landscape in Europe in the field of water data is scattered and fragmented. Solutions have been developed by individual organizations focussing on their own narrow needs.

This act as a barrier to data sharing as each individual solution has its own data models and data standards. This reduces the value of the data generated for others. As the data must be transformed into other formats to make the data eventual interoperable. In doing this several subjective decisions will be made which reduces the reliability of the data. It is costly as changes in one system will require changes in another system.

Experience suggests that the cost of constantly making sure that the central IT systems are aligned with the decentral system. It is cheaper to develop and service all users directly through centralized and standardized systems.

However, a centralized system may not cater well enough for local priorities, furthermore, it will probably face still opposition from vested interests in the various organizations.

So instead of developing a centralized system we recommend to focus on the developing on software components, which the different organizations can use in their own solutions either through API's or as embedded components. This will maintain the ability to adopt to local priorities while reducing the overall IT development costs and improving standardization.

The components could, e.g., be:

- Access to a semantic baseline for various sub-domains such as the one endorsed by OGC and WMO: WaterML2 Part 3 (Surface HydroFeatures) and GroundWaterML2 (WaterML2 Part 4)
- Standardized code lists which can be used through APIs, such as the beforementioned chemical parameters lists
- Components for handling data exchange with laboratories, planning and quality assurance
- A standard meta-data catalogue and data distribution components

The components should be developed based on open source principles and be developed in an organic manner. Preferably as a joint initiative between institutions and countries or where components already developed by one country or one organization are adopted to suit the needs of other countries and organizations.

**Action:**

Initiative a study to identify possible components which can be used jointly and the barriers to wide-spread implementation of these components.

EU funding programmes should prioritise supporting the development across member states and EU institutions of joint components and systems.

Component development supported by the EU should mandate open source so that the components developed are accessible to others.

Standard code lists should be commissioned for development by the EU Commission in cooperation with the EEA and selected member states and funding for the operation of these should be made available.

# ANNEX 1 - ABOUT WATER4ALL

Access to clean water is a fundamental human right, yet millions of people worldwide lack this necessity. Water Pollution levels are at levels making achievement of good ecological status more a fantasy than realistic. Floods are occurring with increasing frequency and damage.

Recognizing the importance of addressing these issues, the European Union (EU) has launched several initiatives to ensure that all citizens have access to safe and clean drinking water, prevent floods and droughts etc. One such initiative is the Water4All Partnership, a comprehensive European endeavor aimed at improving water quality and availability across Europe.

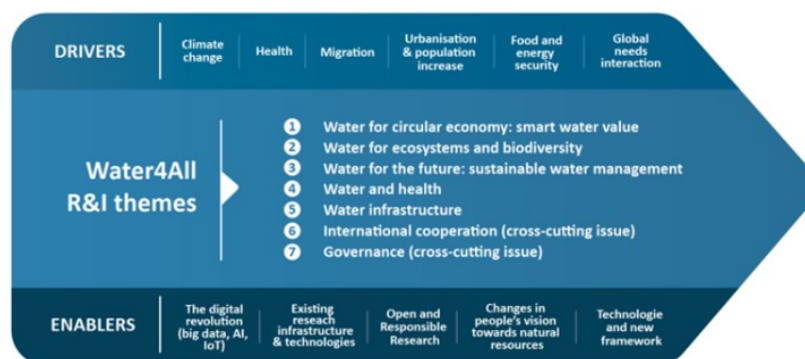
The Water4All Partnership is a collaborative effort involving various stakeholders, including governmental bodies, non-governmental organizations (NGOs), research institutions, and industry partners. Launched by the European Union, the Partnership aims to address water-related challenges such as water scarcity, pollution, and inadequate infrastructure. Water4All gathers more than 90 partners representing the whole Research and Innovation (R&I) chain. Water4All runs its activities across five thematic and two cross-cutting themes of its Strategic Research and Innovation Agenda (SRIA), with a preliminary budget of 112 M€, including EU contribution.

The Water4All Partnership focuses on delivering sound knowledge to address global water challenges, and recognizes in its “Open Science Open Data Strategy”<sup>8</sup> the significance of sharing knowledge and data to achieve its objectives. In line with the Horizon Europe Model Grant Agreement, the partnership emphasizes the application of open science, open data practices, and adherence to the FAIR principles.<sup>9</sup>

In Subtask C.4.3: Toolbox for managing water related data, the sharing of water-related data will be implemented through the development of interoperable interfaces for finding and accessing data thus contributing to a vision of a digitalized European Water Sector based on Open Data.

This White Paper on Best Practices in Data Management is aimed a wider European Discussion and is not only for internal purposes, despite the actual work will strive to be in accordance with the suggestions of the White Paper.

The Water4All’s Strategic Research and Innovation Agenda (SRIA) include five themes in the areas of circular economy, ecosystems, sustainable water management, water and health and infrastructures, as well as two cross-cutting themes. Digitalization (The digital revolution “big data, AI, IoT”) is considered a key enabler for addressing the vast challenges within these five themes:



<sup>8</sup> <https://research-and-innovation.ec.europa.eu>

<sup>9</sup> [European Commission \(2021\). Model Grant Agreement V1.1](#)

## ANNEX 2 - EUROPEAN INITIATIVES ON WATER DATA SHARING AND PROMOTION OF FAIR DATA

In the following a non-exhaustive list of European initiatives focusing is presented:

Name of Initiative	Activities	Information
Stars4Water	The STARS4Water Metadata Portal is an open access, flexible and modular environment, easily adaptable to the different needs of the River Basin Organizations. It aims to unlock existing data and information sources for water resources management and climate change adaptation, including new developments at EU and global level and lessons learnt from previous studies on data collection and data standards.	<a href="https://stars4water.eu/">https://stars4water.eu/</a>
EOSC	The EOSC Association works to advance Open Science in the service of creating new knowledge, inspiring education, spurring innovation and promoting accessibility and transparency.	<a href="https://eosc.eu/">https://eosc.eu/</a>
EMODNet	The European Marine Observation and Data Network (EMODnet) is the European Commission (EC) in situ marine data service of the EC Directorate-General Maritime Affairs and Fisheries (EC DG MARE) and funded by the European Maritime Fisheries and Aquaculture Fund. Established in 2009, EMODnet plays a pivotal role as a trusted source of in situ marine environmental and human activities data and data products, serving a diverse user base across various sectors. The foundation of EMODnet is primary data from Europe's in situ ocean observation community. These data are diverse in the parameters they measure, the temporal and spatial scale that they provide, and the source of the data collection efforts	<a href="https://emodnet.ec.europa.eu/en">https://emodnet.ec.europa.eu/en</a>
AqualNFRA	The AqualNFRA project aims to develop a virtual environment equipped with FAIR multi-disciplinary data and services to support marine and freshwater scientists and stakeholders restoring healthy oceans, seas, coastal and inland waters. The AqualNFRA virtual environment will enable the target stakeholders to	<a href="https://aquainfra.eu/">https://aquainfra.eu/</a>

	store, share, access, analyse and process research data and other research digital objects from their own discipline, across research infrastructures, disciplines and national borders leveraging on EOSC and the other existing operational dataspace.	
GSEU	To develop the geological data infrastructure - building on the existing EGDI - to provide permanent access to and dissemination of the data and information services developed under the project and beyond, targeting a wide range of stakeholders, with the specific aim of enabling further innovation and strengthening the market uptake of innovative solutions;	<a href="https://www.geologicalservice.eu/">https://www.geologicalservice.eu/</a>
ICT4Water	The ICT4Water cluster is a hub for EU-funded research and innovation projects on ICT applied to water management.	<a href="http://www.ict4water.eu/">http://www.ict4water.eu/</a>
SWAN Forum IGU	A collaborative effort of global, SWAN utilities working together to address the challenges faced by the water sector. Our mission is to develop a digital ecosystem that supports interoperable applications and consistent asset data structures, simplifying digital solution adoption and procurement for water utilities worldwide. By focusing on asset data structure and interoperability reference architecture, we aim to create a more flexible, innovative, and efficient water sector.	<a href="http://www.swan-forum.com">Interoperable Utility Group - SWAN Forum (swan-forum.com)</a>
WaterVerse	WATERVERSE mission is to develop a Water Data Management Ecosystem (WDME) for making data management practices and resources in the water sector accessible, affordable, secure, FAIR (Findable, Accessible, Interoperable, Reusable), and easy to use, improving usability of data and metadata, as well as the interoperability of data-intensive processes, thus lowering the entry barrier to data spaces, enhancing the resilience of water utilities and boosting the perceived value of data and therefore the market opportunities behind it.	<a href="https://waterverse.eu/">https://waterverse.eu/</a>
Ideation	<b>IDEATION</b> is an EU-funded project focused on creating a Digital Twin Ocean (DTO) of inland waters, linking rivers, lakes, and wetlands with the	<a href="https://ideation-euproject.eu/storage/2026/01/Attachment_0-7.pdf">https://ideation-euproject.eu/storage/2026/01/Attachment_0-7.pdf</a>

	<p>ocean. The project's success depends on the collaboration of an experienced consortium of 11 European partners. Key recommendations from Ideation:</p> <ul style="list-style-type: none"> <li>• Establish a European interoperable digital ecosystem for water management</li> <li>• Mainstream stakeholder-centred digital twin development</li> <li>• Accelerate water efficiency and climate resilience through predictive digital twins</li> <li>• Use digitalisation to support the implementation of the EU water acquis</li> <li>• Create enabling conditions for large-scale deployment of water digital twins</li> </ul>	
<p>EEA – European Environment Agency</p>	<p>The European Environment Agency (EEA) is an agency of the European Union and provides valuable insights on the state of Europe's environment. Thanks to reliable data collected from our extensive network, we actively support Europe's environment and climate policies. Together with the Eionet network, the EEA collects and distributes data via its datahub.</p>	<p><a href="https://www.eea.europa.eu/en/datahub">https://www.eea.europa.eu/en/datahub</a></p>

# ANNEX 3 - EU SOLUTION FOR REGULATING CHEMICAL SUBSTANCES IN THE ENVIRONMENT.

## Problem

In a highly digitalized world, the EU legislation on chemical substances in the environment is still words written on paper. In the many EU directives and appendixes covering the monitoring of chemical substances, the substances are listed unstructured as plain text, without any unique identifier, sometimes in a table, sometimes abbreviated and randomly with external references.

Translating directives into national regulations, surveillance programs, and ultimately into laboratory contracts and analyses is a time-consuming and error-prone process. There is a risk that important details may be lost in translation, leading to errors and varying interpretations of which substances to measure and how to measure them.

At the national level this makes it in essence close to impossible to track the monitoring of chemical substances across directives and thus across different media in our environment. Do we monitor the same substances in our groundwater as in our drinking water? It is a simple question, it will take hours to find the answer, and you will most probably get it wrong!

Being able to track how toxic chemicals spread, from groundwater into human tissue is extremely time consuming, because the data gathered has almost no interoperability. Everyone in the environmental sector in the European Union recognize the problem. There are many regional, national solutions in every country, but the real solution lies in finding a common unified approach.

In fact, when the marine researchers in Denmark had found their solution on how to identify and register chemicals in the seabed, they unintentionally created another problem, for the broader use of the data.

This will often prompt the valid question: "Isn't the real issue that no one can agree on adopting one of the existing classifications already available?".

Any classification of chemicals is designed with specific purposes in mind. For example, the CAS Registry, created by the American Chemical Society (ACS), was developed to meet chemical industry needs. If the need arises for the Danish EPA to add a newly identified degradation product of a pesticide to the CAS Registry, it would not be possible.

Likewise, the European List of Notified Chemical Substances (ELINCS) was created as part of the EU's regulatory framework for managing chemicals. Its main purpose was to document and regulate substances notified for marketing within the European Economic Area (EEA). A degradation product of a pesticide does not belong to the list.

To illustrate why we cannot use a list created for the regulation of commercial activities, we have compiled a list of some of the shortcomings of REACH/EC-numbers below:

- The EC numbers in the list are not associated with CAS numbers or chemical unique identifiers. You can't even look up e.g. "Trifluoroacetic acid" (TFA), one of Europe's currently most investigated chemical substances in environmental monitoring.
- The EC numbers do not cover all chemical substances, incl. degradation products which are monitored for in the environment.
- The EC numbers are not associated with monitoring data (wastewater, surface water, groundwater, bathing water, drinking water, etc.), but an EU parameter list will be able to make the connection.

- The EC numbers are not linked to the unique IDs used in the WISE reporting.
- The EC numbers are not linked to the EQS found in the Water Framework Directive or other EU legislation.
- The EC numbers do not contain popular names of substances, e.g. PFOS, which is widely used.
- The EC numbers do not contain references to the parts of EU legislation in which they are regulated with limit values or the like.
- The EC numbers are not digitized and therefore cannot be used immediately.

The lack of a common unified approach to the problem has a cost. The administrative burden of decoding regulation is found on all levels of the value chain, state level, regional level, municipalities and in private companies. These dispersed efforts, by highly skilled chemists, have a direct impact on quality and most important on the lack of interoperability of the data produced. IT systems can't interact, reporting becomes manual processes, workload increases exponentially with every new directive.

There is a need to create a solution for the classification of chemicals and a corresponding digitized version of all regulation in environmental analysis across all media, from seabed analysis to livestock feed, to human blood samples.

#### Solution

The Danish "Parameter List" exemplifies a unified approach. The solution caters for all EU and National regulations across all the different media and for the whole value chain. From national agencies to municipalities to private enterprises.

The Danish parameter list assigns a unique code to all physical, chemical, and microbiological parameters reported in Danish environmental regulation. In the list, the parameters can be associated with metadata securing their unambiguously description. I.e. chemical parameters are added information regarding exact chemical structure, so there is no doubt about the identity of the chemical.

The parameters can also be added into groups (e.g. pesticides, metals, priority substances, river basin specific pollutants or parameters included in the EQS for dioxins and dioxin-like compounds) and be part of one or many groups.

Specific parameters can also be associated with threshold values in the parameter list, e.g. environmental quality standards (EQS) or drinking water standards. It is also possible to link the threshold values and the related parameters, to specific analytical quality requirements as defined in the directives, e.g. Commission Directive 2009/90/EC of 31 July 2009. This enables a digitization of environmental legislation. Example of this application can be seen on page 6.

Standardization of parameters involved in environmental regulation in the EU, especially the unambiguous naming and identification of substances and substance groups, has a wide range of benefits outlined below.

It is worth highlighting here that standardization across the EU will ensure that legislators, officials, and citizens have a more comparable basis for assessing and addressing problematic issues such as the prevalence of PFAS in the EU surface waters, because the measurements are based on identical compounds.

The potentials for the EU and the EU countries using a shared unique digital code system within environmental monitoring and regulation are many:

#### *Enhanced data quality*

The quality of environmental data in European countries will increase due to use of the unique code unambiguously describing the identity of a parameter. There will be no doubt about the identity of a parameter. Thus, the quality of data reported to the EU, e.g. via WISE, will also increase. Centralized grouping, e.g. of priority substances, will also decrease the risk of errors at national level.

Digitized environmental legislation can elucidate the analysis quality requirements associated with specific measurements and thus contributes to improving data quality.

#### *Efficient workflows*

The unique code can be coupled to additional information for instance associated with analysis (NORMAN network) and legislation (ECHA), which will contribute to fewer manual errors and more efficient workflows. Digitized environmental legislation and centralized digital grouping, e.g. of priority substances, will also contribute to more efficient workflows at national level.

#### *Increased interoperability*

Data will be easier to compare across countries due to harmonized data. For instance, it becomes obvious which country measure the linear PFOS and which measure the sum of linear and branched PFOS for the parameter "PFOS".

#### *Nuanced overview*

It will be possible to draw a more detailed and accurate pollution picture cross border. In principle, a unique code can be created for any environmental relevant parameter, thus making it possible to share knowledge and create an overview beyond the mandatory EU-WISE reporting system. For example, it would be possible to easily display which pesticides contribute to the ambiguous parameter "sum of pesticides" in which countries.

#### *Increased knowledge exchange*

A common platform displaying environmental data based on unique codes improves the international exchange of information on new environmental substances, acting as an early warning and input system for national and EU watch-lists.

#### [Recommendation](#)

In essence, the proposal, which has already been successfully implemented in Denmark, is to create a classification system tailored to environmental regulation. This would allow for the digitization of regulations and promote interoperability of environmental chemical analysis results across the Union. Paving the road to automating many processes, including reporting to the EU.

The Danish EPA and the Danish Environmental Portal has jointly developed the Parameter List. What began as a modest IT investment quickly became crucial component driving everything else forward.

Except from a continuous strong governance by the Danish EPA in creating the content of the list, there have been no implementation activities amongst users. Technology suppliers, municipalities, regulators, and laboratories quickly spotted the obvious benefits and what we have seen, has been a self-driven pull-effect.

There is ample reason to believe that an implementation of a Parameter List on EU-level, would be an even bigger game changer, than it has been in Denmark. For further details, see Annex 3A.

# ANNEX 3A – THE PARAMETER LIST IN DETAILS

## What is the Parameter List?

The Parameter List involves the unique identification of chemical substances to be measured and the authoritative interpretation of relevant legislation, which has grown increasingly complex and error prone.

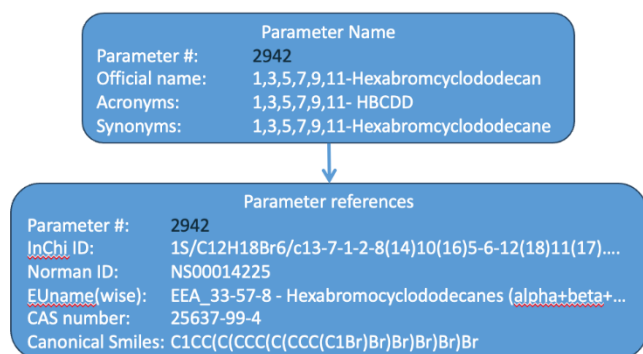
Significant time and resources were invested by government bodies, private companies affected by the legislation, and laboratories, all striving to correctly interpret and comply with the rules. Yet, despite the effort, there remained uncertainty — everyone knew the process was inconsistent, even if it appeared to be done correctly.

## Unique identification of chemical substances

The idea behind the Parameter List, was to create an authoritative repository for chemical substances, that could serve as a single point of truth.

The basis of this list is the creation of a parameter, the user must assign an official name to the parameter, and relevant acronyms and synonyms. Secondly the parameters unique references are entered.

In the figure below is an example of how this registration has been done:



The Parameter List is complete! The information above has been registered for all the approximately 2500 chemical substances on the list. The work has been carried over a two-year period by a group of chemists of the Danish EPA, which administers the Parameter list.

This includes the common data terms for surface, groundwater and marine developed for reporting to EEA - the [WISE codelist](#). We use the codelist for reporting under the WISE SoE (Water Information System for Europe -State of Europe. [https://cdr.eionet.europa.eu/help/WISE\\_SoE](https://cdr.eionet.europa.eu/help/WISE_SoE). There are about 900 substances in the list: where a CAS number is available, we use that.

The codelist includes marine but data reporting for the marine regions is currently limited because the data model uses WFD water bodies as the basic unit.

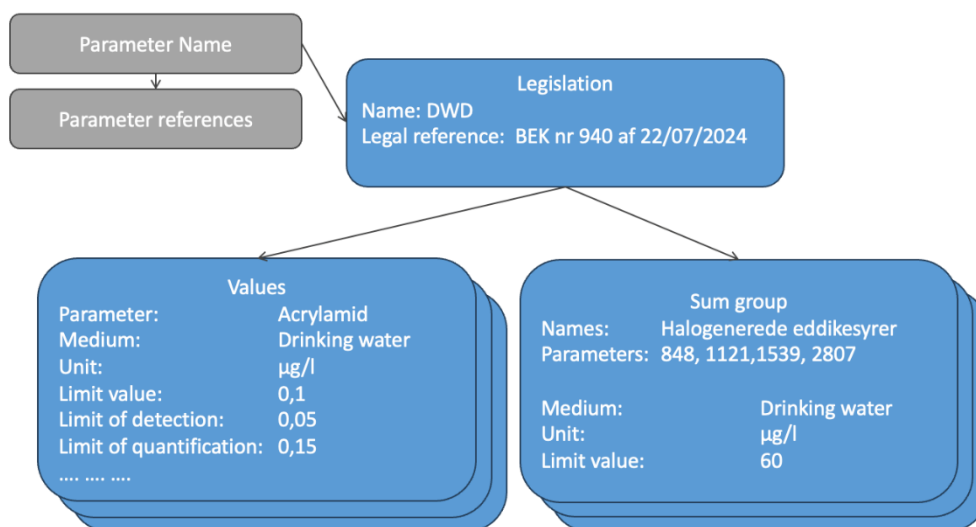
There are some significant changes planned for chemicals in the European system, with “[one substance, one assessment](#)” as a goal for European agencies . Together with the proposals for reporting under the Environmental Quality Standards Directive, which would make ECHA responsible for processing data under the watch list and for priority substances etc, we expect there to be a need to update our approach to chemicals reporting in the coming years, not least with technological advances for analysing and reporting chemicals.

### Authoritative interpretation of legislation

The legislative efforts regarding chemical substances in the EU include numerous values such as limit values, detection limits, quantification limits, relative uncertainty, etc. Despite this, the legislation has remained entirely analog so far.

The Parameter List holds the possibility to create legislative “digital twins”. The Danish EPA has released a digital version on the Drinking Water Directive, the Ground Water Directive and of specific analytical quality requirements as defined in the directives.

The figure below is an example of digital legislation in the Parameter List:



### Applications

Like most repositories, the Parameter List has numerous applications. Its publicly accessible webpages are used by government agencies, universities, laboratories, waterworks, waste treatment plants, and others. The popularity is evident from the number of companies that have subscribed to the mailing list to receive notifications whenever new information is added.

This will be nothing compared to the benefits of system-to-system integration through the APIs (application programming interface) of the Parameter List. Laboratories can integrate and make sure quality requirements are always met, 98 municipalities can integrate and automatically detect if any limit value is exceeded. Improving both quality and efficiency. The Danish EPA can use the Parameter List to get a national overview over exceeded values.

# ANNEX 4 - RECOMMENDATIONS FROM OTHER INITIATIVES

Other European initiatives have looked into what it would take to promote data sharing and FAIRification of data. Most of these initiatives have had a particular focus on data from technical infrastructure e.g.:

## Wataverse

WATERVERSE demonstrates that integrating digital innovation, synthetic data, and multi-stakeholder engagement enhances the efficiency and resilience of water management systems. Policymakers are encouraged to adopt the following six recommendations:

1. Promote Co-Creation through Stakeholder Forums: Facilitate Multi-Stakeholder Forums (MSFs) by strengthening the inclusion of various experts, policymakers, and government representatives to align technological innovation with needs in the water sector at local and regional levels<sup>19</sup>.
2. Foster the adoption of AI and data management technologies to digitalise the water sector: WDME leverages advanced technologies to enhance the entire data management lifecycle - from collection and fusion to processing, analysis, and visualisation of heterogeneous data - thereby promoting data sharing, interoperability, and enabling the transition toward smart water management. Further, extend existing open Data Models from the Smart Data Models program or create new ones aiming to ensure (semantic) interoperability of data and metadata<sup>20</sup>.
3. Foster a FAIR and transparent water sector: Generate FAIR and linked water data to improve accessibility, interoperability, and reusability across stakeholders. By promoting data FAIRness, the sector can enhance collaboration among public authorities, researchers, and private actors<sup>21</sup>. This
4. Leverage Smart Data Models for supporting semantic interoperability: FIWARE Smart Data Models help break down silos, enable efficient collaboration, sharing, and unlock the full value of water data<sup>22</sup>.
5. Strengthen Data and Metadata Quality and Accessibility: Apply FAIR Data and MELODA<sup>5</sup> dimensions (Reputation and Dissemination Level) to optimize data usage, consultations and exchange across stakeholders<sup>23,24,25</sup>.
6. Improve Real-Time Data Processing: Implement advanced query performance models to ensure faster, quality-driven data processing.

## AquaSpice

1. Encourage the implementation of the Water Efficiency Framework (WEF). The WEF fosters a holistic approach to assessing and elevating water efficiency through digital and technological advancements. Foster collaborative approach among the different stakeholders to develop the relevant innovative solutions, facilitate knowledge sharing and adoption of the solutions by industries.
2. Support active engagement with standardization organizations such as ETSI, ISO, CEN to be updated with emerging industrial standards.
3. Encourage the implementation of standards and interoperability frameworks such as FIWARE in real-world scenarios to enhance efficiency, reliability, and scalability in water management practices.
4. Encourage the integration of SAREF Ontology, developed by ETSI<sup>2</sup>, to facilitate the semantic interoperability.

# ANNEX 5 - DEFINITIONS OF FAIR DATA, OBSERVATIONS AND MEASUREMENTS PRINCIPLES, DATA TYPES AND DATA VALUE CHAIN

## FAIR data

The dynamic around FAIR principles stem from the 2016 publication ‘The FAIR Guiding Principles for scientific data management and stewardship’<sup>10</sup>. Since then, there is an international incentive towards applying those principles in the global scientific community.

As mentioned in the reference literature<sup>11</sup>, the “principles emphasise **machine-actionability** (i.e., the capacity of computational systems to find, access, interoperate, and reuse data with none or minimal human intervention) because humans increasingly rely on computational support to deal with data as a result of the increase in volume, complexity, and creation speed of data”.

At its core of this approach are the FAIR principles, which are data which meet principles of findability, accessibility, interoperability, and reusability (FAIR) for both Human AND machines.



The first step in (re)using data is to find them. Metadata and data should be easy to find for both humans and computers. Machine-readable metadata are essential for automatic discovery of datasets and services, so this is an essential component of the FAIRification process

Once the user finds the required data, she/he/they need to know how they can be accessed, possibly including authentication and authorisation.

The data usually need to be integrated with other data. In addition, the data need to interoperate with applications or workflows for analysis, storage, and processing.

The ultimate goal of FAIR is to optimise the reuse of data. To achieve this, metadata and data should be well-described so that they can be replicated and/or combined in different settings.

## Observations and Measurements – starting point for the IT architecture

<sup>10</sup> Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* **3**, 160018 (2016). <https://doi.org/10.1038/sdata.2016.18>

<sup>11</sup> <https://www.go-fair.org/fair-principles/>

No matter how much data is available, or how advanced your digital capabilities are, it is essential that the baseline needs to be as harmonized as possible. Every difference implies time spent on unproductive matters – data washing.

Water4All call for a European Water Data Ecosystem to use semantic web metadata standards to make water sensors available on the web via the Observation and Measurement standard, already laid down in an Iso-standard<sup>12</sup>, which places the object (“Something”) and location (“Somewhere”) at the core of matters. This is the feature, which we aim to observe.

Further, Water4All call for making the registration of data across various sub-domains more aligned and less complex. A domain driven approach where it is explored if data from different sub-domains such as groundwater, surface water and marine water could use very similar or perhaps even similar data models for physical parameters, chemical parameters and biological parameters should be explored. If data models across sub-domains could be made more uniform this would increase the interoperability of data across sub-domains and make the IT infrastructure to support these data far less complex and hence cheaper.

An example is achieving interoperability regarding chemical parameters by digitalizing relevant EU directives and providing access to a shared codelists with unique identifiers and semantics for the chemical parameters. See Annex 6 for more details.

Other international structures have defined similar principles, e.g. the US “InternetOfWater”<sup>13</sup>. Further, several international standards exist, which – if implemented – on the technical side could constitute strong guidance for implementation of best practices in water data management. Regrettably, use of these standards is, at best, scattered, and will no coherence to regulatory steps as well as addressing organization, cultural and resource barriers. For further details on the barriers, see next chapter.

The “InternetOfWater” program states the following principles for harmonizing water data management, which very well together with what Water4All White Paper is based on:

- Water data are essential for efficient, equitable, sustainable, and resilient water planning, management, and stewardship.
- Modern data infrastructure increases the usefulness of water data and enables its broadest possible application.
- Data equity is necessary for water equity; modern data infrastructure should be implemented and governed so that data is usable by and for overburdened communities.
- All water data produced for the public good should, by default, be findable, accessible, interoperable, and reusable (FAIR) for public use or authorized users.
- Security and privacy risks associated with sharing data can be mitigated using mechanisms for tiered access for authorized users.
- Commonly accepted data, metadata, and exchange standards should be adopted by water data producers to promote interoperability, efficiency, sharing, equity, and secondary uses of data
- Control and responsibility over data are best maintained by data producers.

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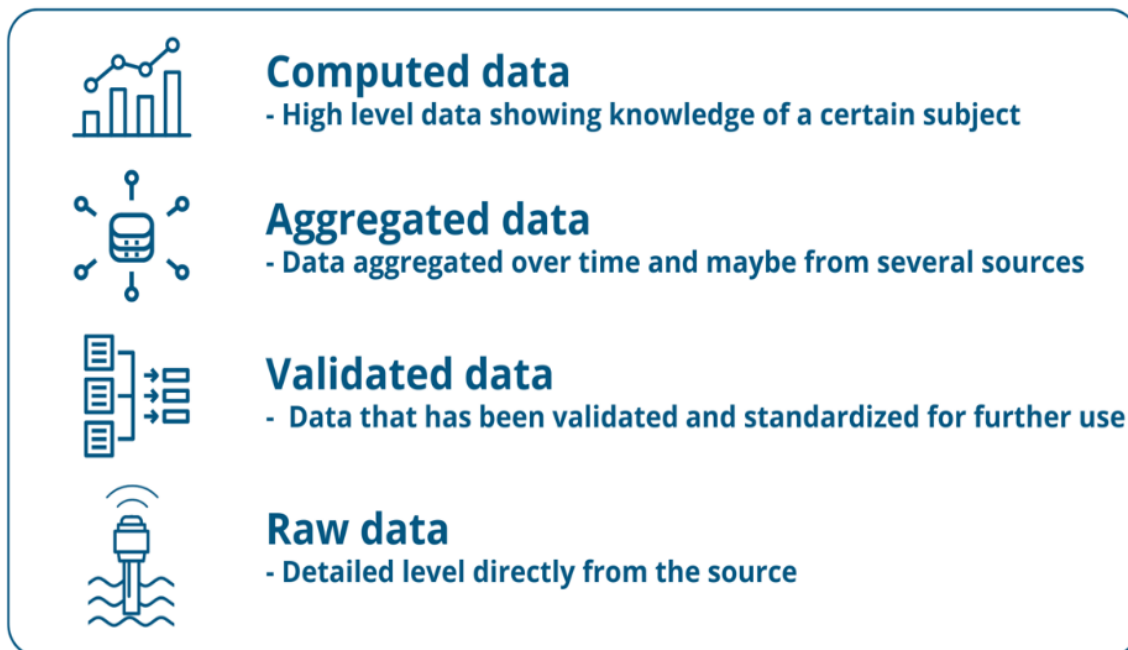
<sup>12</sup>

[https://en.wikipedia.org/wiki/Observations\\_and\\_Measurements#:~:text=Observations%20and%20Measurements%20\(O%26M\)%20is,in%20sampling%20when%20making%20observations.](https://en.wikipedia.org/wiki/Observations_and_Measurements#:~:text=Observations%20and%20Measurements%20(O%26M)%20is,in%20sampling%20when%20making%20observations.))

<sup>13</sup> [www.internetofwater.org](http://www.internetofwater.org)

- Data producers are responsible for sharing data of known quality and documenting essential metadata; data users are responsible for determining whether data are appropriate for specific purposes and uses.
- Federated, distributed systems of interoperable public water data generally provide scalability and flexibility to meet the diverse needs of data producers and users.

#### Different types of data



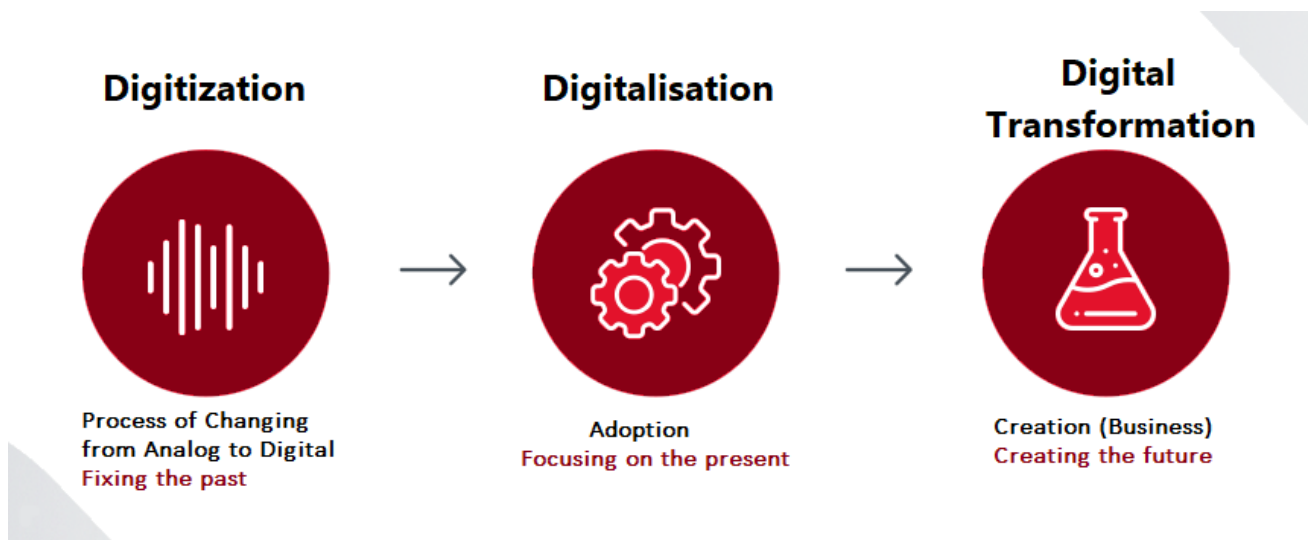
Many of the API's, based on sensor standards, are describing, and exchanging data on a detailed sub-domain level. Basically, they are describing raw data, produced by a sensor or some human observations.

The starting point, however, could be a "higher" level of data sharing. We might need to develop special API's that are able to share data on both aggregated and computed level and rules on HOW TO aggregate and compute data.

The current standards on "Observation, Measurements and Samples" could serve as a standard for sharing data on a higher level if we document and share how it is done.

#### Defining Digitalization

The term digitalization is widely used, but ideally a more detailed terminology following the trajectory of Digitization, Digitalization and Digital Transformation should be used.



This process has been determined by a variety of factors - the growing capacity of computers and IT systems; investment capacity and incentives structures for the organizations; availability of data, and not least availability, or rather lack of, systematic FAIR data.

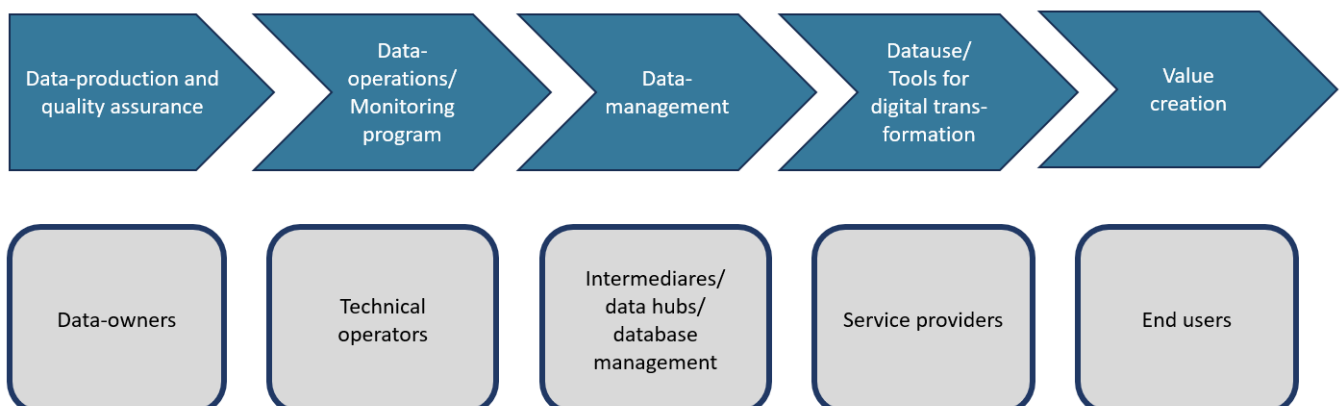
The process has unfolded at very different speeds. Increasingly, decisionmakers tend to expect data-driven input to the work processes a.o. due to the increasing complexity and cross-sector and cross-border nature of the challenges. Some organizations are now all-in on AI, while at the same time others, both public authorities and utilities, lack basic housekeeping of their data, e.g. with incomplete data sharing even inside organizations leading to data use coming with huge uncertainties.

Systematic data is key to efficient work processes and making the right management decisions and investments.

#### Value chain for water data sharing

The fragmented characteristics of the Water Sector have been mentioned several times throughout this White Paper. This is highly important to take into account when considering the actual steps towards a European Water Data Ecosystem.

Several different types of stakeholders should be taken into account:



### **Data-Owners and Technical Operators**

Relates to the original (and often local) data flows, where an organization (*Data Owner*) invests in monitoring stations with sensors installed to measure continuous flows and samples at regular or ad hoc frequency measuring selected parameters, and where an *Operator* undertakes operational responsibilities at technical level, including compiling the data produced.

Often the “raw”-data undergoes a quality assurance step which is also usually performed by the data-owner

### **Data management – The need for an Intermediary**

A key component of the value chain are the data services that assemble, standardize and harmonize data from multiple (often hundreds) of different sources into FAIR data layers that can then be used for decision-making and other applications, in other words FAIR data offered by open and free digital services to the data use/tools for digital transformation.

When data flows are merged across several monitoring stations, an *Intermediary* is needed. In single stream data flows, the *Operator* eventually also becomes the *Intermediary*, however when data flows are merged across several different streams, an *Intermediary* is needed with a technical infrastructure allowing for this to be possible. This comes with huge costs, and the more different the original Data Models are, the more expensive this functionality becomes.

Often these costs are not taken into account by the Leadership level, but with this White Paper an approach is suggested which on one hand will lower costs and increase productivity of Data Management, but – importantly – will also contribute to increase harvesting the potential of data to be reused across different sources. Precisely for this role, the organizational aspects should be carefully considered, especially a co-owned approach involving all government levels undertaking monitoring tasks is recommended to ensure adequate IT management to constitute the main focus of this structure, or, otherwise, a quite comprehensive regulatory framework to ensure an unbiased approach is needed. A solution to this would also be to advocate the need for Chief Data Officers (CDOs) at the leadership level of organisations.

To be more direct, just placing the intermediary role as a unit under the national EPA may lead to various operational deficiencies.

### **Data use and value creation**

This potential includes the perspective of allowing researchers, domain experts and innovators to access **relevant data** representing the **relevant problems** of end-users - hereby increasing **relevant results** of these stakeholders. Eventually end-users e.g. authorities and utilities should have a substantial interest in this, but will also have to carry investments, or parts of these.

### **Data Portals versus Data Spaces – a distinction**

Bringing on National Water Data Portals as a key element in building a European Water Data Ecosystem eventually requires getting the terminology right vis-à-vis the concept of Data Spaces. The concept of Data Spaces has gained some traction during recent years, although not really becoming concretized in a large number of cases.

In this White Paper, the following, simplified distinction is used:

- A National Water Data Portal is a registry and repository ideally for all publicly monitored water quantity and quality, made available in a FAIRified format. Eventually, this could include data from technical Water Infrastructure, and, further, ideally it should include other, relevant biosphere data

as decision support systems increasingly require cross-sector and cross-administrative boundaries data. It is highly recommended that a National Water Data Portal is organized with all levels of government being co-owners, in order to allow for the Portal to serve joint organizing of water data, while at the same time avoiding building of customized solutions to the needs of one organization only. Importantly, a National Water Data Portal should provide data free of charge And, ideally, with an unlimited number of users from all aspects of society, hereby creating the foundation for shaping a Digital Economy in the Water Sector.

- A Data Space organizes data sharing among a limited number of users for a limited use case and purpose. This may come in different shapes and sizes, but the distinction is that it is limited. A Data Space sets clear governance framework for access to these data, ownership and use of the data.

Use Data Spaces for bounded, purpose-specific sharing. Some collaborations — an urban water management system combining precipitation, infrastructure and recipient data; a river-catchment management arrangement crossing administrative boundaries — involve a limited set of organizations working toward a specific purpose. These are best served by Data Spaces: governed arrangements that define access, ownership and use rules among a defined group of participants. Data Spaces complement rather than replace NWDPs: the Portal carries the broad public reference layer, while Data Spaces handle bounded use cases where a full open-access model is not appropriate.

For more information about the concept of Data Spaces, reference can be made to e.g. IDSA, the International Data Space Association<sup>14</sup>.

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<sup>14</sup> [Home - International Data Spaces](#)